

## The Evaluation of the Relationship between Serum Calcium Level and Stylohyoid Length in Adults

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**Abstract-** Elongation and calcification of the stylohyoid apparatus is probably related to Eagle's syndrome and may cause such symptoms as facial pain and dysphagia in patients. In the present study, the relationship between serum calcium level and stylohyoid apparatus length was studied in adults referring to the dental college of Yazd. This was a cross-sectional descriptive study on 50 adult patients above 20 years old (28 men, and 22 women) referring to the radiology ward of the dental college. The stylohyoid ligaments were measured from the base of the skull to the bony tip of each appendix by panoramic radiograph. Mineralization of the ligaments more than 30 mm on the panoramic radiographs was considered abnormal. The serum calcium level of all patients was then measured. Data were analyzed by t-test and Pearson's correlation analysis. Mean length of the stylohyoid apparatus was  $27.36 \pm 9.10$  mm and was not related to age and sex. An elongation rate of 26% was obtained. The mean serum calcium level was  $9.39 \pm 0.57$  mg/dl and there was not a statistically significant difference in serum calcium level between various age groups and genders. There was no relationship between the length of the stylohyoid apparatus of each side and serum calcium concentrations in different age groups. It appears that the length of the stylohyoid apparatus is not related to serum calcium level within our patient population.

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### Introduction

The stylohyoid ligaments apparatus rests in the head and neck region and its length is about 25 mm in adults (1). Its apex is in the region between the internal and external carotid arteries. Any change in the apparatus such as calcification can affect the internal and external carotid arteries and nerve terminals in the region and lead to some complications in the patient (2). Eagle's syndrome is a condition that may involve the stylohyoid apparatus. Elongation and calcification of this apparatus leads to such symptoms as facial pain and dysphagia (3). Stylohyoid syndrome and pseudo-stylohyoid syndrome also affect this apparatus (3).

Wardrop and coworkers realized that elongation of the stylohyoid apparatus is a common symptom of menopause and is usually treated by hormone replacement (4). Similarly, Okabe and coworkers while studying calcified stylohyoid apparatuses noted a

relationship between elongation of the stylohyoid apparatus, serum calcium concentration and heel bone density (5).

In the present study, in order to study the relationship between serum calcium concentration and elongation of the stylohyoid apparatus, panoramic radiographs and serum calcium concentration of the patients were evaluated. Calcification of the stylohyoid ligament usually starts from the base of the skull downward and is bilateral, but in rare cases, calcification can start in the small horn of the hyoid bone or from the center of the ligament. Conditions resulting in calcification of the stylohyoid ligament include Eagle's syndrome, stylohyoid syndrome and calcification of the stylohyoid chain. Calcification of the stylohyoid ligament is usually observed accidentally on panoramic radiographs. In one study, elongation of the stylohyoid apparatus was observed in 2-28% of the population under study (6). The stylohyoid ligament is

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calcified to some extent in different individuals of any age.

On panoramic radiography, the linear calcification advances forward from the region of the mastoid and progresses from the postero-inferior ramus toward the hyoid bone. The hyoid bone is almost parallel to the inferior part of the lower cortex of the mandible or may be superimposed on it (7). The stylohyoid appendix is visualized as an elongated, cone-shaped, thin and radio-opaque structure with a thick base and is directed downwards and forwards. The normal length is between 5–25 millimeters (7).

## Materials and Methods

This was a cross-sectional descriptive study on 50 patients above 20 years old (28 men and 22 women) who had referred for panoramic radiography to dental college from 2007 and 2011 and had a clear panoramic radiograph showing the stylohyoid ligament (without technical, appearance and fixing faults such that the appendix of the ligament could be traced from the skull base). None of the patients had any history of facial injury, vitamin D consumption or bleeding disorders such as hemophilia.

The panoramic radiographs were taken by a Plan Meca 2002 EC Proline machine (made in Helsinki, Finland) with the maximum power and amperage of 80 KW and 12 mAmp and time period of 18 seconds. Mineralization in all parts of the stylohyoid and stylomandibular regions was considered as mineralization in the stylohyoid ligament. The

stylohyoid ligament complex was measured from the base of the skull to the tip of each appendix. All measurements were made by using a transparent ruler on the panoramic radiographs. The appendix length was measured accurately on both sides and the magnification factor was calculated. Figure 1 shows a standard panoramic radiograph. All subjects were referred to a laboratory between 7 am and 3 pm and a 3 ml blood sample was drawn from them. The serum calcium level in milligrams/deciliter (mg/dl) was measured. Data were coded and entered in SPSS (Ver. 16). Statistical tests included Chi-square and Kruskal Wallis tests.

After explaining the research protocol, an informed consent was obtained from each subject. The proposal of this study got approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences.

## Results

From 50 subjects, 28 (56%) were men and 22 (44%) were women. From women, 6 (27.3%) subjects were menopausal. Mean age of the subjects was  $42.18 \pm 12.57$  years (range: 22-72 years). The minimum length of the stylohyoid complex on the right side was 10 mm and the maximum length was 60 mm (mean:  $26.54 \pm 9.31$  mm). The minimum length of the stylohyoid complex on the left side was 10 mm and the maximum length was 45 mm (mean:  $28.18 \pm 8.90$  mm).

Table 1 and 2 show the serum calcium concentration and stylohyoid apparatus length in different age groups, and table 3 shows serum calcium level in different genders.



**Figure 1.** A sample of panoramic radiography with clear view of the stylohyoid ligament

**Table 1.** Mean serum calcium concentration in different age groups

Age group	Number	serum calcium concentration (mg/dl)			
		Mean	SD	Minimum	Maximum
22-44	27	9.5	0.58	8.5	10.5
45-72	23	9.27	0.55	8	10.5
Total	50	9.39	0.57	8	10.5

**Table 2.** Mean right and left stylohyoid complex length in different age groups

Age group	Number	length of right and left stylohyoid complexes (mm)								P value	
		Mean		SD		Minimum		Maximum			
		Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
22-44	27	24.37	23.44	7.49	8.16	15	11	42	45		
45-72	23	29.08	29.39	10.68	8.81	10	10	60	45	0.074	0.017
Total	50	26.54	26.18	9.31	8.90	10	10	60	45		

In this study, a stylohyoid complex length of 30 mm was considered abnormal and 13 (26%) and 14 (28%) cases on the right and left side showed pathological stylohyoid complex lengths. The serum calcium concentration was 8–10.5 mg/dl (mean: 9.39±0.57 mg/dl). Considering the normal values of serum calcium (i.e. 8.5-11 mg/dl), abnormal calcium level was observed only in one case (2%) and none of the subjects had calcium levels above normal range. Pearson correlation coefficient (r) for age and stylohyoid complex length on the right side was 0.245 which was not statistically significant (P=0.086), but this measure on the left side was 0.403 which was statistically significant (P=0.004). There was no statistically significant correlation between age and serum calcium levels (r=0.075, P=0.603).

In the present study, there was a significant correlation between left and right stylohyoid complex (r=0.632 and P<0.000), but Pearson correlation test failed to show a significant correlation between the right and left stylohyoid complex length and serum calcium level (r=0.076, P=0.60, and r=0.083 and P=0.564, for right and left sides, respectively). Table 5 shows this

association. In both age groups, there was no significant relationship between serum calcium concentration and left and right side stylohyoid complexes. Table 6 shows mean serum calcium concentration on the basis of menopausal status.

Mean serum calcium level in individuals with normal and pathologic right side stylohyoid complex length was 9.42±0.58 and 9.33±0.56 mg/dl, respectively and the difference was not statistically significant. This measure for normal and abnormal left side stylohyoid complex length was 9.44±0.56 and 9.29±0.60 mg/dl, respectively and this difference was not statistically significant as well.

**Table 3.** Mean serum calcium concentration in different genders

Gender	Number	Serum calcium concentration (mg/dl)			
		Mean	SD	Minimum	Maximum
Male	28	9.49	0.51	8.60	10.5
Female	22	9.28	0.63	8	10.30
Total	50	9.39	0.57	8	10.5

**Table 4.** Mean right and left stylohyoid group length in different age groups

Sex	Number	length of right and left stylohyoid complexes (mm)								P value	
		Mean		SD		Minimum		Maximum			
		Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Men	28	27.00	27.86	9.61	9.00	14	11	60	45	0.698	0.134
Women	22	25.95	24.05	9.11	8.49	10	10	45	42		
Total	50	26.54	26.18	9.31	8.90	10	10	60	45		

**Table 5.** Comparison of serum calcium levels between individuals with normal stylohyoid complex length and those with pathological left and right side stylohyoid length

Condition	Number	Serum calcium concentration (mg/dl)								P value	
		Mean		SD		Minimum		Maximum			
		Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
Normal	37	9.42	9.44	0.58	0.56	8	8.50	10.50	10.50		
Pathologic	13	9.33	9.29	0.56	0.60	8.60	8	10.50	10.50	0.648	0.410
Total	50	9.39	9.39	0.57	0.57	8	8	10.50	10.50		

**Table 6.** Mean serum calcium concentration on the basis of menopause state

Condition	Number	Serum calcium concentration (mg/dl)			
		Mean	SD	Minimum	Maximum
Non menopausal	16	9.42	0.60	8.50	10.30
Menopausal	6	8.88	0.57	8	9.70
Total	22	9.27	0.63	8	10.30

## Discussion

There are various reasons for elongation and calcification of the stylohyoid complex that include surgical trauma, localized chronic stimulation, presence of mesenchymal particles, endocrine disturbances during menopause in women, trauma and physical pressure during growth (4,8). Some researchers believe that there is a relationship between stylohyoid complex length, serum calcium concentration and heel bone density (5). Panoramic radiography is used in patients with pain related to increased stylohyoid complex length in order to study the increased length and calcification of the stylohyoid apparatus (6,9-11).

In the present study, 50 subjects were studied. From 50 panoramic radiographs and 100 stylohyoid complexes studied, the mean stylohyoid length on both sides was  $27.36 \pm 9.10$  mm that is similar to the results of the Bushehri study ( $21.78 \pm 7.65$  mm) (12), but is different from the results of the study by Erol (48.15 mm) (13) and Okabe (36.7 mm) (5). This difference may be due to the difference in the populations under the study in the Erol and Okabe study (13,5). Also a difference in the age groups could have caused the difference since in the Okabe study, all patients were above 80 years old and as most of the studies have stated (14-17), the stylohyoid complex length increases with age.

In our study the rate of stylohyoid complex length elongation was 26%. This rate was 26.8%, 40%, 4%, 3.9% and 84.4% in Bushehri (12), Correl (18), Bozkier (9), McDonald (19) and Ferrario study (15), respectively. It seems that the variations in elongation of the stylohyoid apparatus could be related to the

difference in race of the populations under the study which is clear in the McDonald study (19) and also the difference in the study methodology. Ferrario (15) stated that this difference could be due to difference in parameters for selection of patients and evaluation of radiographs. Savrenlar (20) has stated that the most accurate method for measuring stylohyoid apparatus length is CT scan, but it can't be used in epidemiological studies due to the high x-ray exposure and cost.

Similarly, clinical signs and symptoms related to the stylohyoid elongation were not observed in any of those with stylohyoid elongation. Anbiyayee (17) reported that the stylohyoid elongation can be a physiological phenomenon. Correl (18) also stated that mineralization of the stylohyoid apparatus is a common finding and can be responsible for signs and symptoms in a limited number of cases. In the present study, considering the high rate (26%) of elongated stylohyoid apparatus (length >30mm) and absence of any clinical signs and symptoms in any of the cases, it can be concluded that the elongation of the stylohyoid apparatus is a physiological process, not a pathological one.

In the present study, the correlation between age and length of the stylohyoid apparatus on the right side was not statistically significant, but it was significant on the left side. A relationship has been reported between the stylohyoid apparatus length and age in most of the studies (14-17), though others have reported otherwise (12,18).

There was no significant relationship between the elongation of the stylohyoid apparatus on both sides and gender that is similar to the findings of the studies by Correl (18), Bozkier (9), Rizatti (10) and Okabe (5). In addition, there was a correlation between the length of

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the stylohyoid apparatus in the left and right sides which is similar to the most of the studies (5,12,21,22).

In the present study, there was no significant difference in the serum calcium concentrations in various age groups and genders. In addition, there was no relationship between the stylohyoid apparatus length and serum calcium concentration on both sides in various age groups. This is different from the results of the Okabe study (5) in which there was a significant relationship between serum calcium concentration and stylohyoid apparatus length. This difference could be due to the sample size of the studies (50 in the present study, and 659 in the Okabe study). Another reason could be the difference in race (Iranian versus Japanese) and geographical areas which may affect the environmental conditions. The difference in the age of the populations under the study could also be responsible for the difference, as in the Okabe study (5) all subjects were above 85 years old, whereas in the present study, the age range was between 22 and 74 years.

In the present study, there was no significant difference in length of the stylohyoid apparatus between non-menopausal and menopausal women. This is not consistent with the results of the Wardrop study (4) and the difference could be due to the fact that only 6 subjects were menopausal in the present study. In conclusion, in the present study, a total of 50 patients were studied to determine the relationship between serum calcium concentration and stylohyoid apparatus length. The mean stylohyoid apparatus length was  $27.36 \pm 9.10$  mm. Elongation of the stylohyoid apparatus (length > 30 mm) was present in 28% and 26% of the subjects on the left and right sides, respectively.

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